Space Weather Technical Forecast

Issued on Monday, 27 March 2023 at 12:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1 Minor radio blackouts. Active electron fluence Likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with occasional minor C-Class flares recorded at GOES16, the largest being a C4.6 flare at 27/0636 UTC. There are now nine numbered and one unnumbered sunspot regions on the visible disc. AR3256 remains the only magnetically complex region on the disk, with all other regions relatively small, stable and magnetically simple. No Earth-directed CMEs were observed in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured at L1 by ACE, showed Earth transiting out of the negative polarity High Speed Stream from CH86/-, with the phi angle accordingly negative (towards the Sun) throughout. The solar wind speed fell from elevated, close to 600 km/s, back down to slightly elevated, around 400 km/s. The solar wind density was roughly level around 10ppcc observed, it did however increase to near 20 ppcc between 26/1200-1500 UTC. The IMF was at or below 8nT over the 24 hours, with the north-south component varying between +4/-4nT. The net result of the above solar wind measures was for mostly Quiet (Kp 0-2) geomagnetic activity, with a single Unsettled (Kp 3) period between 26/1800-2100 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 remained at Background levels.

The high energy electron flux (greater than 2MeV) measured at GOES16 started at Moderate levels then rose to generally High from 27/0230 UTC, with a peak of 1190 pfu observed at 27/0955 UTC. The associated 24-hour fluence remained below the Active (1e8 integrated pfu) threshold, with a continued increasing trend. At 27/0001 UTC the observed fluence was 3.74e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is most likely to remain Low, but with a Chance of becoming Moderate with any isolated M-class flares. The main region likely to give such flares is AR3256 in the southwest.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the forecast. The current fast wind enhancement from CH86/- is expected to continue easing through the period from slightly elevated to slow-ambient. The next coronal hole expected to impact Earth is CH88/-, possibly late on day 4 (30th).

Quiet to Unsettled (Kp 0-3) geomagnetic activity is expected through the period. Later on day 4 (30th), if we see the CIR from CH88/-, geomagnetic activity may increase to Unsettled with Active intervals and a slight chance of G1/Minor geomagnetic storms.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to remain at Background levels, but with a Slight Chance of reaching S1 or greater, should any significant flares occur.

The high energy (greater than 2 MeV) electron flux is currently High and is likely to rise further,

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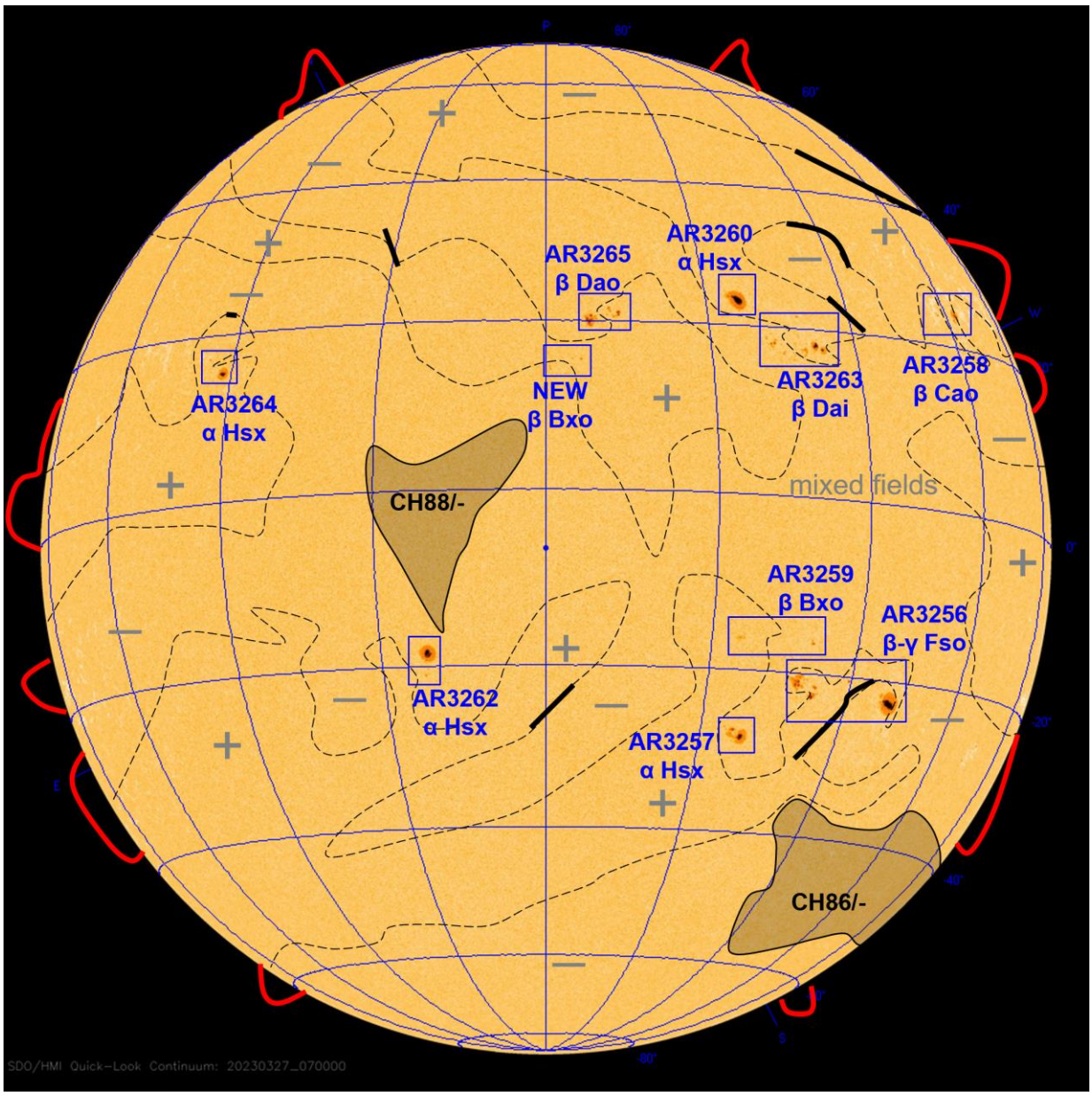
probably breaching the 1000pfu High threshold at times each day through the period. The associated 24-hour fluence is expected to continue on an upward trajectory, with Active (1e8 integrated pfu) conditions possible by the end of day 1 (27th) before becoming Likely days 2 and 3 (28th/29th).

Figure 1. Solar Analysis Valid 27/0700 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

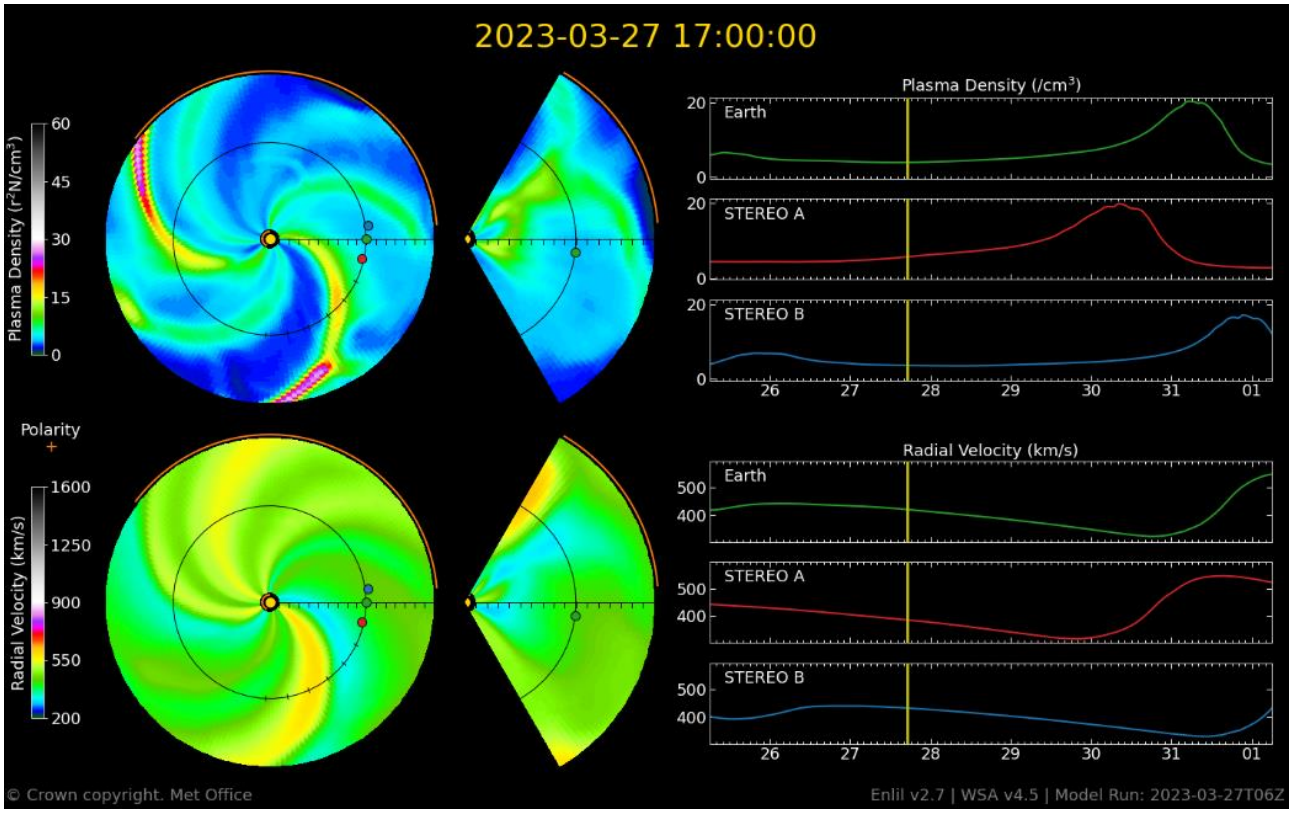
No Earth-directed CMEs feature in the forecast.

The current fast wind enhancement from CH86/- is expected to continue easing through the period from slightly elevated to slow-ambient. The next coronal hole expected to impact Earth is CH88/-. This appears slightly further west than the previous rotation so it's possible we may see its HSS and possibly CIR late on day 4 (30th).

Quiet to Unsettled (Kp 0-3) geomagnetic activity is expected through the period. Later on day 4 (30th), if we see the CIR from CH88/-, geomagnetic activity may increase to Unsettled with Active intervals and a slight chance of G1/Minor geomagnetic storms.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC ENLIL.



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Radio Blackouts - X-Ray Flares:

There are currently ten sunspot regions on the visible disc, nine numbered and one new region. AR3256 remains the longest most magnetically complex region on the disk and is the source of several C-class flares in the past 24 hours, the largest being a C4.6 flare at 27/0636 UTC. All of the other active regions appear stable and magnetically simple, with only minor fluctuations in areal extent.

Solar activity has been Low over the past 24 hours, with occasional minor C-Class flares. There remains a Chance of M-class flares, most likely from AR3256.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: 24 hour X-Ray trace.

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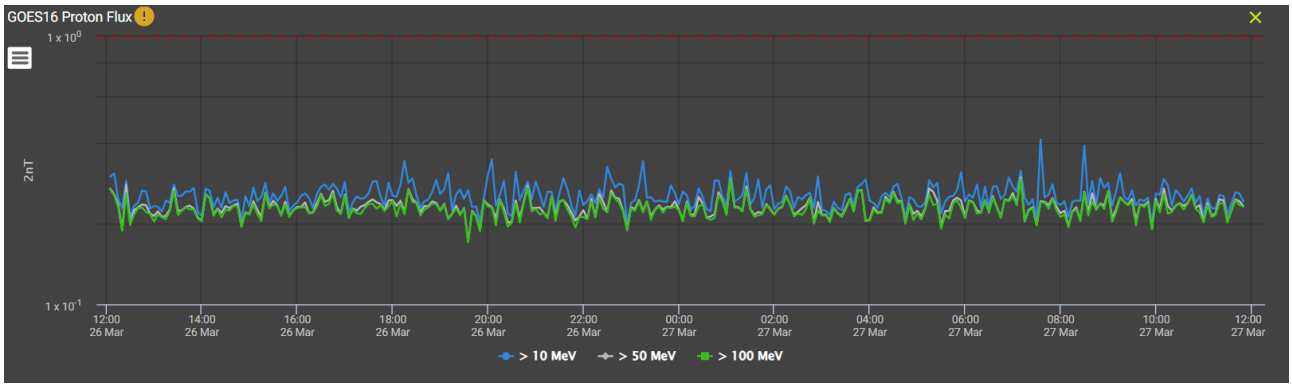
Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES16 is currently at Background levels.

Proton flux is most likely to remain at Background levels, but with a Slight Chance of reaching S1 or greater should any larger flares or significant CMEs occur.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: 24 hour Proton trace



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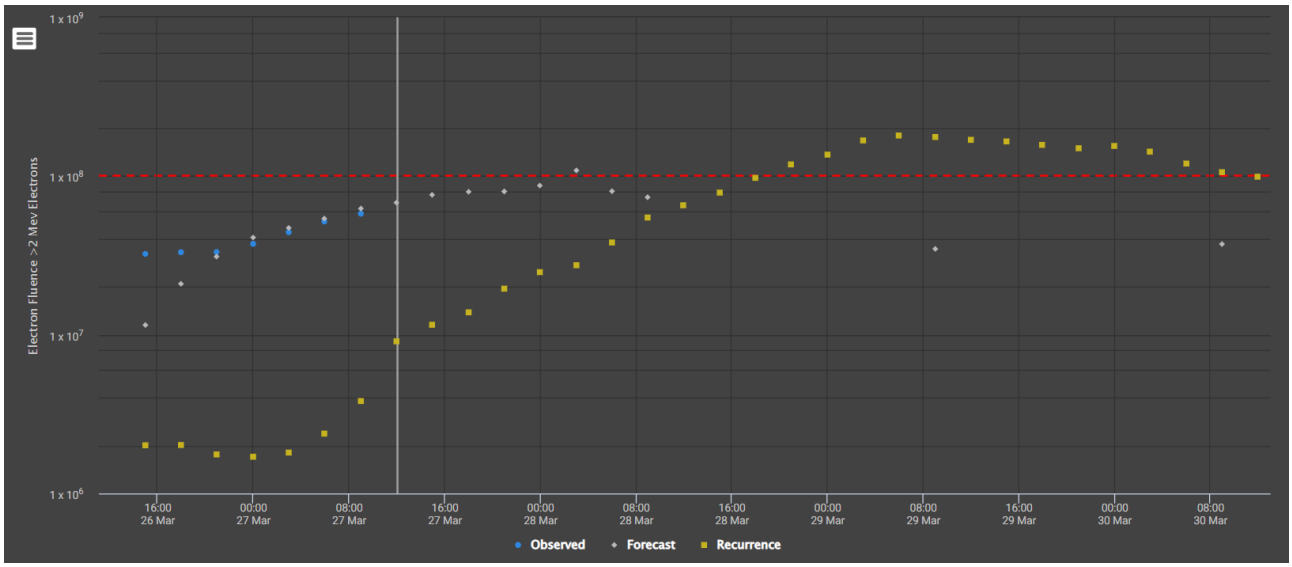
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux is now at High levels. There is considered a reasonably strong potential for further day-on-day increases in flux during days 1 to 3 (27th-29th), possibly extending into day 4 (30th) of the four-day forecast period, with the 1000pfu High threshold now considered Likely to be breached at diurnal maximum each day in the expected absence of further significant geomagnetic activity.

Active 24-hour integrated electron fluence perhaps carries a Chance of being realised on day 1 (27th March). It is considered Likely that Active fluence levels will be reached on day 2 and 3 (28th-29th March), this reduces to a chance on day 4 (30th).

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	50	70	60	40
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: REFM integrated flux/fluence forecast, recurrance and observations.



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